PRINCETON

HX-12E

High Resolution Color Monitor

SERVICE MANUAL

HX-12E

High Resolution Color Monitor

For the IBM PC and Compatibles

SERVICE MANUAL

PRINCETON®
GRAPHIC SYSTEMS

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P500-11/88

FOREWORD:

Throughout this manual you will see warnings and precautions relating to the service of the *HX-12E* monitor. Please read and observe all warnings, notes, and precautions. Dangerous voltage and current levels are present within the covers of this monitor. There may be residual voltage and current present in this unit, although it has not been used for some time. For your safety, please refer all service to qualified technicians. **Princeton Graphic Systems** maintains a full staff of qualified technicians to provide quick, authorized service. We recommend that you send your monitor to **Princeton Graphic Systems** for authorized service.

Princeton Graphic Systems will not be liable for any injury or damages caused by any internal adjustments, repairs or modifications not performed by authorized **Princeton Graphic Systems** staff.

Your **Princeton Graphic Systems** *HX-12E* is covered by a one (1) year parts and labor warranty against all defects in material and workmanship. Should your monitor require service within this one year period, you should have the unit serviced by an authorized **Princeton Graphic Systems** service facility. **Any unauthorized service will void your warranty.** Your warranty will be void if any modification is made to this monitor. Please refer to your warranty card for complete information.

Should your monitor require service, or should you need technical assistance, please call or write to:

PRINCETON GRAPHIC SYSTEMS
1125 Northmeadow Parkway, Suite 120
Roswell, GA 30076

Tel.: (404) 664-1010
(800) 221-1490
Fax: (404) 664-4103 (Sales & Support)

Please supply a detailed description of the problem, the model and serial number of your unit, the make and model of your display controller, the type of PC you are using, and the circumstances of the problem. **Princeton Graphic Systems'** hours are between 9:00 am and 5:30 pm, Monday through Friday (Eastern Standard Time).

Before returning any monitor to Princeton Graphic Systems for service, you must get a Returned Material Authorization [RMA] number from **Princeton Graphic Systems.** *EQUIPMENT RECEIVED WITHOUT A PROPER* RMA *NUMBER PRINTED ON THE OUTSIDE OF THE BOX CAN NOT BE ACCEPTED AND WILL BE RETURNED.*

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1.0 PURPOSE:

This publication is for the use of **Princeton Graphics Systems** employees, and authorized third party maintenance organizations. While this may be provided to other persons on request, *the presentation of this document shall not be construed as permission to open the monitor and/or perform any internal adjustments, repairs or modifications.* Please read the paragraph in section 9.0 entitled "Disclaimer" for complete details.

This publication will provide schematics, block-diagrams, troubleshooting flowcharts, parts lists, safety and set-up procedures for servicing the *HX-12E* monitor. In order to assure the continued safe and reliable operation of the monitor, all safety and set-up procedures should be followed completely each time the monitor is opened for any adjustment.

2.0 WARNING:

The *HX-12E* monitor, as well as all **Princeton Graphic Systems** products, is covered by a full one (1) year warranty against any defects in materials or workmanship. Should your monitor fail to operate as specified within one (1) year from the date of the original retail purchase, you **must** return the monitor to **Princeton Graphic Systems** or an **AUTHORIZED Princeton Graphic Systems** service organization for proper repairs. If, at any time, the monitor is opened by persons not authorized by **Princeton Graphic Systems,** the warranty for that product will be null and void.

This monitor, as well as all other monitors, operates with high voltage and current levels. These voltages may continue to be present long after power has been disconnected from the monitor. Service should be performed only by experienced, qualified individuals. For your own protection, you should never service any electrical device without having someone present to provide aid in the event of an emergency.

3.0 EQUIPMENT REQUIREMENTS

In addition to the monitor, you will need the following:

IBM or compatible PC, PC/XT, or PC/AT with 256K RAM, 1 Disk Drive.
PC-DOS or MS-DOS 210 or higher.
IBM Enhanced Graphics Adapter, (EGA), or compatible.
Phillips screwdriver.
3/8 inch and 1/4 inch slotted screwdrivers
Non-metallic TV alignment tool kit.
DC Voltmeter.

Also recommended are:

High-Voltage probe for voltmeter.
Triggered Oscilloscope for 20 MHz or higher bandwidth.
A.C. Isolation Transformer with safety fuse.
Graphic Systems Software (GSS) Virtual Device Interface (VDI) for EGA.
Princeton Graphic Systems *HX-12E* test diskette.

4.0 IMPORTANT SERVICING SAFETY PRECAUTIONS:

Only qualified, authorized persons should attempt any servicing of this monitor. Please be thoroughly familiar with all of the following safety checks and service guidelines before removing the cover of the monitor.

4.1 WARNING:

1. For continued safety and service, do not attempt to modify any circuit in this unit.
2. Disconnect AC power source before servicing unit.
3. The transister heat sinks are potential shock hazards when power is applied to the monitor.

4.2 SERVICING OF HIGH VOLTAGE AND PICTURE TUBE:

When attempting to service the high voltage system, remove the static charge from the CRT by using a 10K ohm resistor in series with an insulated wire (such as a test probe) to short the anode lead of CRT to the chassis.

The Cathode Ray Tube (CRT) uses integral implosion protection. Please follow the following safety precautions:

1. Discharge static high-voltage completely before handling the CRT.
2. Wear shatter-proof safety goggles when handling the CRT.
3. Do not lift CRT by the neck.
4. Always replace the CRT with the same type and number.

4.3 X-RADIATION AND HIGH VOLTAGE LIMITS:

1. X-Radiation is potentially dangerous and should be approached with extreme caution.
2. The only potential source of X-radiation is the CRT. If the high voltage is kept at factory set levels, there are no measurable X-ray emissions from the CRT.
3. Only if the high voltage exceeds the factory set levels is the X-radiation capable of penetrating the shield of the lead filled picture tube. Therefore, it is vital to maintain the high voltage at specified levels.
4. Operation at higher voltages could also cause failures in the CRT or high voltage circuitry.
5. When servicing a monitor with excessive high voltage, avoid being unnecessarily close to the monitor. Also, do not operate the monitor longer than necessary to locate the defect.
6. Every time a monitor chassis is serviced, the brightness should be adjusted while the high voltage is being monitored with a meter. This is necessary to assure that the high voltage is not excessive and that the regulators are operating properly.
7. An accurate high voltage meter should be available at all times.
8. Replace the cathode ray tube (CRT) only with the type and model specified and do not make unrecommended circuit modifications.

4.4 SAFETY NOTICE:

Many electrical and mechanical parts in this monitor have special safety related characterisitcs. These characteristics are often not evident from visual inspection, nor can the protection afforded by them be necessarily increased by using components rated for high voltage, power, etc.

Parts which have these special safety characteristics are identified in the parts list at the end of this manual. Please refer to this list before replacing any parts. For continued protection, replacement parts must be identical to those used in the original circuit. The use of a substitute part which does not have the same safety characteristics as the part specified in this service manual may create shock, fire, X-radiation, or other hazards.

4.5 FIRE AND SHOCK HAZARD:

Perform the following checks before returning the unit to customer:

1. Assure that no hardware is lodged between the chassis and any metal parts in the monitor.
2. Check to see that no insulation or dressing is pinched, cracked or otherwise faulty.
3. Check all the non-metallic protective devices such a control knobs, cabinet backs, insulating fishpapers, inc.
4. To insure against shock hazards, check for leakage current in the following manner:
   - Plug monitor AC cord directly into AC outlet. Do not use an isolation transformer for this test.
   - Connect one end each of two clip leads to a 1.5K ohm, 10 watt resistor paralleled by a 0.15μF capacitor (drawing below).
   - Connect an AC voltmeter with 1K ohm per volt (or higher) sensitivity across the resistor.
   - Connect one clip lead to a known ground (such as a water pipe). Use the other lead to check all exposed metal parts (i.e., screws, screw posts, knob posts, signal connector, etc.) while checking the AC voltage drop across the resistor.
   - Repeat the above with the AC connector reversed (it may be necessary to use an adapter plug.)

Any reading of 0.3 Volt RMS (equal to 0.2 mA AC) or more is **DANGEROUS** and **MUST BE CORRECTED!**

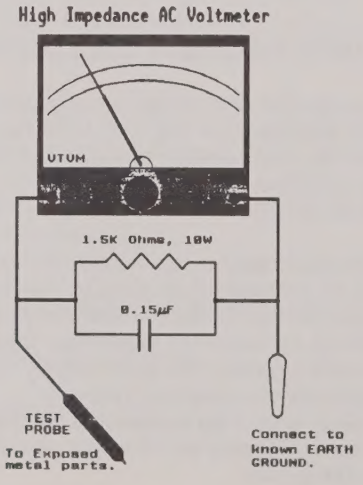


Figure 4.1

Functional Specifications

5.0 OVERVIEW:

The *HX-12E* is a dual frequency, high-resolution color monitor designed to display both text and graphics. The monitor will display 640 x 350 in 16 colors from a total palette of 64 colors with an IBM *Enhanced Graphics Adapter* (or equivalent) in the high-resolution color mode, or 640 x 200 in up to 16 colors with the IBM *Color/Graphics* or *Enhanced Graphics Adapter* (or equivalents) in the low resolution color mode.

5.1 GENERAL INFORMATION:

The *HX-12E* has a high-resolution 12" display for alphanumeric (text) and graphic use. It is capable of operating at 15.75 kHz or 21.8 kHz horizontal frequencies. An etched CRT is used for glare reduction. External controls consist of Power On/Contrast control, Brightness control, Horizontal Sync Adjust, and Vertical Sync Adjust. The *HX-12E* is UL listed and certified to comply with the Class B limits pursuant to subpart J of part 15 of FCC rules.

	15 kHz MODE	**21.8 kHz MODE**
Receivable Frequency Range:	Video signal frequencies to 20 MHz.	
Display Modes:	Color/Graphics	Enhanced Graphics
Vertical Sync Required:	Positive	Negative
Colors displayable:	16	64
Character cell size*:	8 wide x 8 high	8 wide x 14 high
Characters per row*:	80	80
Rows per frame*:	25	25
Horizontal resolution*:	640	640
Vertical resolution*:	200	350
Video dot frequency*:	14.318 MHz	16.257 MHz
Scanning mode:	Non-interlaced	Non-interlaced
Compatibility:	Color/Graphics Adapter	Enhanced Graphics Adapter

Note that items marked with "" are typical specifications. The actual specifications will depend on the controlling video card used.

5.2 SIGNAL & TIMING:

	15.75 kHz MODE	**21.8 kHz MODE**
Video Signals:	Red Green Blue Intensity	Red[1] Green[1] Blue[1] Red[2] Green[2] Blue[2]
Video Dot Frequency:	14.318 MHz	16.257 MHz
Horizontal-		
Frequency:	15.75 kHz	21.8 kHz
Pulse Width:	3.97μs	4.943μs
Back Porch:	8.34μs	1.84μs
Front Porch:	6.68μs	0
Active Video Period:	44.7μs	39.367μs
Vertical-		
Frequency:	60 Hz	59.5 Hz
Pulse Width:	0.19ms	0.6ms
Back Porch:	2.14ms	0.1ms
Front Porch:	1.6ms	0.045ms
Active Video Period:	12.74ms	16.06ms

Timing diagrams on page 19.

All specifications subject to change without notice.

5.3 INPUT CHARACTERISTICS

5.3.1 Connector: 9 pin, female, "D" type subminiature metal connector - DB-9.

5.3.2 Pin connections:

PIN#	SIGNAL	PIN#	SIGNAL
1	Ground	6	Green$_2$/Intensity
2	Red$_2$	7	Blue$_2$
3	Red	8	Horz Sync
4	Green	9	Vert Sync
5	Blue		

5.3.3 Signal Levels & Impedance:

Video (Pins 2 thru 7):	Positive TTL, 3.4 ±1V=ON, 0.0 ±0.4V=off. 470 Ohms minimum with 5 pF maximum
Horizontal Sync:	3.4 ±1V=SYNC positive, 0.0 ±0.4V=low. 470 Ohms mininum with 1000pF maximum.
Vertical Sync:	3.4 ±1V = HIGH, 0.0 ±0.4V = low. 470 Ohms minimum with .01±F maximum.

5.4 MODE INFORMATION:

5.4.1 Signal Requirements:

PIN#	15.75 kHz	21.8 kHz
1	Ground	Ground
2	Ground	Red$_2$
6	Red	Red$_1$
4	Green	Green$_1$
5	Blue	Blue$_1$
6	Intensity	Green$_2$
7	Low Signal	Blue$_2$
8	Horz Sync (15.75kHz)	Horz Sync (21.8kHz)
9	Vert Sync (Positive)	Vert Sync (Negative)

5.4.2 Internal sync. control is accomplished by sensing the Horizontal Sync Frequency transmitted from the color card to the monitor via data pin 8. The mode control adjusts the horizontal oscillator screen size, and high-voltage accordingly.

5.4.3 The appropriate video mode (16 or 64 colors) is set by monitoring the polarity of the Vertical Sync pulse sent from the color card to the monitor via pin 9.

5.4.4 Contrast in the 15.75 kHz mode: With the intensity bit low, the external contrast control is operative. Range of adjustment is from approximately one-quarter brightness to at least half brightness. With the intensity bit high, the external contrast control has no effect.

5.4.5 Gray in the 15.75 kHz mode: When the Red, Green and Blue inputs are low and the intensity is high, a gray level, or approximately 1/4 the brightness of the full intense white, is displayed.

5.4.6 Brown in the 15.75 kHz mode: When the Red and the Green inputs are high, and the Blue and Intensity inputs are low, then brown is displayed by attenuating the green output.

5.4.7 Border in the 15.75 kHz mode: Border area is used only in the 15.75 kHz mode. Video extends to the edge of the screen.

All specifications subject to change without notice.

5.4.8 Contrast in the 21.8 kHz mode: The external contrast control should always be operative. *HX-12E monitors with serial numbers lower than TY15087 may require a modification to allow contrast adjustment in this mode.*

5.4.9 Border in the 21.8 kHz mode: The *EGA* card does not support border in the 640 x 350 mode. Therefore, there will be a constant black border around the active display area.

5.4.10 Video Blanking is performed by the monitor during retrace times in both modes.

5.5 ELECTRICAL SPECIFICATIONS:

Power Connector:	IEC type 3 pin connector (IEC320 / CEE22)
Voltage:	(For serial numbers KW17594-KW18949 and serial numbers up to TY16994) 120 Volts AC Nominal, 10% 220/240 Volts AC (Requires a transformer change and modifications)
Voltage:	(For serial numbers KW16886-KW17593, and all serial numbers after KW18950) 90-132 Volts AC 180-264 Volts AC (Requires internal jumper change)
Input Regulation:	Raster size does not vary more than 1.0% over the specified input voltage range with respect to the nominal voltage.
AC Frequency:	49 Hz to 61 Hz.
AC Current Load:	1.0 AMP RMS Maximum.
High Voltage Output:	24 KV
High Voltage Regulation:	The raster size does not vary by more than 4% over the full range of brightness.
Temperature Drift-	
Video:	Less than 20% brightness change.
Size:	Less than 3% of width, Less than 3% of height.
Offset:	Less than 2% of width, Less than 2% of height.

5.6 DISPLAY CHARACTERISTICS:

Cathode Ray Tube (CRT):		12" diagonal, 90°, Black Matrix with dark glass (55% transmission).
Phosphor:		P22-RGB.
Dot Pitch:		0.28mm.
Anti Glare:		Etched CRT.
Light Output:		55FL Minimum.
Display Area:	@ 15.75 kHz:	215mm x 160mm at maximum brightness.
	@ 21.8 kHz:	220mm x 160mm at maximum brightness.
15.75 kHz Offset:		+7mm/-1mm left/right, ±4mm Vert.
21.8 kHz Offset:		±4mm Horz, ±3mm Vert.
Pincushion:		Sides: less than 2.0mm. Top and bottom: less than 2.2mm.
Barrel:		0.4mm Maximum for all sides.
Tilt:		±1.0mm.
Trapezoid:		1.2% Maximum.
Focus:		With "#" displayed in all character positions at 16.27 MHz, 21.8 kHz, 640x350 resolution and 5FL, all the lines of the character should be resolvable.

5.7 ENVIRONMENTAL:

Temperature:	Operating: 15°C to 40°C. Storage: -20°C to 55°C.
Humidity:	Operating: 10% to 80% RH, non-condensing. Storage: 10% to 90% Relative Humidity.

All specifications subject to change without notice.

Altitude:	Operating: Up to 10,000 feet. Non-Operating: Up to 30,000 feet.
Vibration and Shock:	The unit is contructed such that when individually packaged in a normal corrugated container and supported only by its designated mounting points, no damage shall occur using standard commercial shipping methods. Unit constructed to withstand up to 20g shock.

5.8 SAFETY & RELIABILITY:

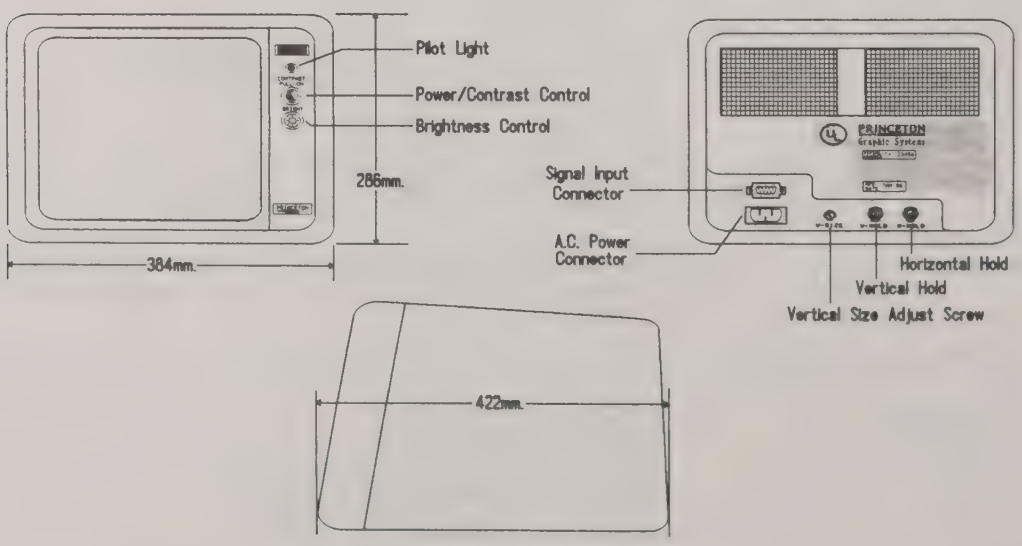
X-Radiation:	Complies with D.H.H.S. regulations; contains X-Ray protection circuitry.
Electrical Safety:	U.L. Listed. C.S.A. approved.
High Voltage Arcing:	All CRT connections protected by spark-gaps.
MPBF (Mean Tie Between Failure):	20,000 Hours.
MTTR (Mean Time To Repair):	0.50 Hours.

5.9 MECHANICAL & MISCELLANEOUS:

Dimensions:	422mm (L) x 286mm (H) x 384mm (W) 16.6" x 11.25" x 15.7".
Weight:	13.3 kg 30 lb.
Cabinet Material:	Flame-resistant plastic.
Cabinet Color:	Beige.
Accessories:	Shielded signal cable with male DB-9 connectors on both ends, power cord to monitor and standard 3-prong AC wall outlet, *HX-12E* Operations Manual, **Princeton Graphic Systems** warranty registration card.
Warranty:	One year against all defects in materials and/or workmanship. Monitor repaired or replaced with unit of equivalent serial number at the sole option of **Princeton Graphic Systems.**

All specifications subject to change without notice.

External Views and Dimensions



6.0 SET-UP PROCEDURE:

6.0.0 Equipment Set-Up:

6.0.1 Configure EGA for enhanced color monitor and install in PC following the manufacturers' instructions.

6.0.2 Place monitor, face down, on a clean, padded surface. Remove four (4) plastic caps covering the four (4) rear cover screws. (2 on top and 2 on bottom), then slide rear cover off monitor. Return monitor to normal position.

6.0.3 Connect *HX-12E* to EGA with data cable supplied with monitor. Ncte that using the wrong data cable may cause improper results. Attach AC power cord to monitor, and plug into a grounded outlet (or isolation transformer).

6.0.4 Turn on computer and boot test program. Allow monitor to operate for fifteen (15) minutes before proceeding any further.

6.1 SYNC. ADJUSTMENT:

6.1.1 Display 16 color bars in 15.75 kHz (640x200) mode. Check that IC102, pin 5 is a TTL high. If not, adjust 15/21.8 kHz Frequency Sensor VR304 until a TTL high signal is present on IC102, PIN 5.

6.1.2 Adjust external Horizontal Sync, VR301 (H-HOLD), to get a stable display. Then adjust the potentiometer to the center of its stable sync range. Turn the monitor off then on to assure monitor remains in sync. Do not be concerned with proper centering of the display at this time.

6.1.3 Turn up brightness until raster is visible. Adjust H-CENTER, VR306, until raster is centered on CRT.

6.1.4 Display crosshatch pattern, and adjust H-PHASE, VR303, until the crosshatch pattern is centered within the raster.

6.1.5 Display crosshatch pattern at 21.8 kHz (640x350). DO NOT ADJUST EXTERNAL H-HOLD (VR301). Check that IC102 pin 5 is a TTL low signal. If not, adjust VR304 to obtain a TTL low signal on IC102, PIN 5 and return to step 6.1.1.

6.1.6 Adjust VR405 to vertically center display on the CRT.

6.1.7 Adjust 21.8 kHz Sub-Frequency, VR302, to obtain a steady, centered display.

6.2 POWER SUPPLY VOLTAGE CHECK AND ADJUSTMENT:

6.2.1 The power/video board is mounted vertically on the side of the monitor. Locate the power connector at the top front of the power/video board. You will see the markings on the solder side of the board indicating which pin of the connector is which voltage (i.e., 5V 15V 74V 92V).

6.2.2 With a DC voltmeter, measure the voltage between the 5V power pin and chassis ground. This voltage should be 5 VDC ± 0.2 volts. *If voltage is out of range, then monitor will require troubleshooting.*

6.2.3 With a DC voltmeter, measure the voltage between the 15V power pin and chassis ground. This voltage should be 15VDC ± 0.6 volt. *If voltage is out of range, then monitor will require troubleshooting.*

6.2.4 With a DC voltmeter, measure the voltage between the 74V power pin and chassis ground. This voltage should be 74VDC ± 1.5 volts. This voltage may be adjusted with potentiometer VR801. *If the proper voltage can not be set with VR801, then the monitor will require troubleshooting.*

6.2.5 With a DC voltmeter, measure the voltage between the 92V power pin and chassis ground. This voltage should be 92VDC ± 1.5 volts. This voltage may be adjusted with potentiometer VR802, which is located at the top front of the power/video board, next to the power connector. *If the proper voltage can not be set with VR 802, then the monitor will require troubleshooting.*

6.2.6 **USE EXTREME CAUTION IN THE FOLLOWING TWO STEPS. CONTACT WITH HIGH VOLTAGE MAY BE FATAL!** Power-off monitor. Connect High-Voltage probe to meter, and attach ground to monitor chassis. Insert high-voltage probe under anode cap on CRT. Attach high-voltage probe to meter and set meter to read DC voltage to 28KV (28,000 Volts). Turn on monitor and display 16 color bars at 15.75 kHz (640x200 resolution mode). Check that anode to chassis ground voltge is within range of 22.5KV to 24.5KV. Adjust high voltage with potentiometer VR801. *If monitor can not be adjusted to operate within this range, then it will require troubleshooting.*

6.2.7 Now set EGA to display 16 color bars at 21.8 kHz (640x350 resolution mode). Check that anode to chassis ground voltage is within range of 22.5 KV to 24.5 KV. Adjust high voltage with potentiometer VR802. *If monitor can not be adjusted to operate within this range, then it will require troubleshooting.*

6.2.8 This is an important safety check. The High-Voltage Protection Circuit is intended to disable the monitor in the event of any failure that may elevate the high-voltage, and cause excessive X-radiation. Improper setting of this circuit may reduce its effectiveness as a safety feature. Adjust VR802 up until High Voltage Protection Circuit activates and shuts down the monitor. This should occur when anode voltage reaches 27KV ± 0.5KV. To reset the monitor you will have to turn down VR802 and turn off the monitor for a minute. Older units allow the trip voltage to be adjusted with potentiometer VR305 on main PC board. Newer units are not adjustable. If monitor does not shut down within specified range, then it will require troubleshooting. Re-adjust VR802 to normal level, as in step 6.2.5.

6.2.9 Adjust FOCUS with VR491 for best overall focus. This control is located on the high-voltage CR block, attached to the top of the Flyback Transformer, T303. Access to the FOCUS is via a cutout in the left side Flyback shield.

6.3 SIZE ADJUSTMENT:

6.3.1 Adjust horizontal width with L303, located on small PC board attached behind the power/video board. L303 is the tall, round variable inductor on this small board. The proper screen width is 215mm.

6.32 Check that horizontal width is the same in both modes. If not, adjust the 74 or 92 volt supply to change the 15 kHz or 21.8 kHz mode screen sizes, respectively.

WARNING! Increasing or decreasing the 74 or 92 volt supply will cause a corresponding change in the high voltage. After each adjustment verify that the anode to chassis ground voltage is within range of 22.5KV to 24.5KV. If adjustment of horizontal width causes the anode voltage to exceed specified limits, then the monitor will require troubleshooting.

6.3.3 In the 21.8 kHz mode, adjust vertical height to 160mm with VR402.

6.3.4 After adjusting height in 21.8 kHz, switch to 15.75 kHz and adjust vertical height to 160mm with Sub V-Size, VR404.

6.4 COLOR ADJUSTMENT: FOR SERIAL NUMBERS UP TO TY15086.

For serial numbers later than TY15086, skip to section 6.5.

6.4.1 Raster Adjustment: (Operating at 15.75 kHz with no video and blank screen.)

a) Set external contrast and brightness controls at maximum.

b) Adjust Sub-Bright, VR601, to get a G1 voltage of -65VDC between CRT pin 7 and chassis ground. This measurement must be made with a high impedance oscilloscope probe or voltmeter.

c) Reduce VR603 (G2) for raster extinction, then increase slightly so a raster is dimly visible. *Note: If the raster can not be extinguished, reduce VR601 nominally to do so. Ideally, G1 should be as close as possible to -65V with brightness at maximum.*

6.4.2 15 kHz Color Balance

a) Display a 16 colorbar pattern at 15.75 kHz.

b) Adjust CRT board gain potentiometers (VR501, VR502, VR503) to obtain the desired color balance and brightness for the half intense colors ONLY.

c) Adjust VR124, VR125, VR126 to obtain the desired color balance and brightness for the eight intense colors, including dark grey (color 8).

d) Display text in all color combinations. Check focus of intense characters. If focus is poor, reduce VR124, VR125 and VR126 to improve, then check color balance again.

e) Adjust VR101 for correct brown.

6.4.3 21.8 kHz Color Balance

a) Display 1/3, 2/3, 3/3 colorhues pattern, and adjust VR121, VR122, VR123 or proper white balance and for even, discernible changes in intensity for the 1/3, 2/3, and 3/3 (full) intensity levels.

b) Display text in all color combinations and check focus of intense characters. If quality of intense characters is poor, then reduce VR121, VR122, VR123 until character are acceptable quality.

c) If 1/3 level is to dim or bright adjust VR501, VR502, VR503 on CRT board to correct, then go back to step 6.4 and start color set-up again.

d) Repeat steps 6.4.2 and 6.4.3 until overall color balance and text quality is acceptable in in both modes.

6.5 COLOR ADJUSTMENT: FOR SERIAL NUMBER HIGHER THAN TY15086.

6.5.1 Raster Adjustment

a) Set EA card to operate at 15.75 kHz, with no video and a blank screen.

b) Set external CONTRAST and BRIGHT controls at maximum (clockwise).

c) Use high impedance oscilloscope probe or voltmeter to measure G1 voltage at pin 7 of CRT. Use Sub-Bright, VR601 to adjust G1 voltage to -65Vdc.

d) Turn all CRT board bias potentiometers (VR504, VR505, VR506) to minimum brightness. (This raises cathodes to approximately 90V)

e) Adjust VR603 (G2) until a raster is dimly visible.

f) Adjust CRT board bias potentiometers, VR504, VR505, VR506 by increasing such color as necessary to obtain a dim WHITE raster.

g) Reduce VR603 (G2) for raster extinction, then increase slightly so raster is dimly visible. NOTE: If raster cannot extinguished, reduce VR602 (G1) as little as required to do so.

6.5.2 15 kHz Color Balance

a) Display a 16 colorbar pattern in the 15.75 kHz mode:

b) Adjust CRT gain potentiometers, VR501, VR502, VR503 to obtain desired color balance and intensity level for half intense colors ONLY. (Color numbers 0 to 7)

c) Adjust VR124, VR125, VR126 to obtain color balance and intensity for the eight intense colors, including dark grey (color 8).

d) Display text in all color combinations and check focus of intense characters. If focus of intense characters is poor, then adjust VR124, VR125, VR126 to improve quality and double check color balance of intense colors.

c) Adjust VR101 for best brown.

6.5.3 21.8 kHz Color Balance

a) Display 1/3, 2/3, 3/3 colorhues pattern.

b) Adjust 1/3 brightness levels for white color balance and sufficient brightness using VR121, VR122, VR123.

c) The 2/3 levels are only affected by the CRT board gain potentiometers, VR501, VR502, VR503. If these require adjustment, step 6.5.2 will have to be repeated to balance 15 kHz colors.

d) Adjust full intense (3/3) colors using only VR127, VR128, VR129, located on the bottom rear of the power/video PC board.

e) Display text in all color combinations. If intense character are fuzzy, adjust VR127, VR128, V129 to correct.

f) Display 1/3, 2/3, 3/3 colorhues pattern again. Check for even, discernible changes in intensity from the 1/3 to 2/3 to full intensity levels. Adjust above listed potentiometers if necessary.

g) Repeat above steps 6.5.2 and 6.5.3 until overall color balance and text quality is acceptable.

6.6 DISTORTION CORRECTION:

6.6.1 Horizontal Linearity can be adjusted using L301. This tuneable inductor is located on the small PC board mounted on the inside of the right chassis side shield. L301 is the metal rectangular case with a slotted screwdriver adjustment. Display a crosshatch pattern, and adjust L301 for uniform horizontal linearity.

6.6.2 Pincushion, Barrel and Trapezoidal distortion can be corrected with VR308 and VR307. VR307 will correct the trapezoidal distortion (where the top of the screen is narrower or wider than the bottom). VR308 will adjust the pincushioning or barrelling.

6.6.3 Vertical Linearity is adjusted with VR403. Display a crosshatch pattern and adjust VR403 until uniform vertical linearity is achieved.

6.6.4 Tilted raster can only be adjusted by loosening the CRT mounting screws and rotating the CRT slightly while watching the display. Be careful not to touch any uninsulated contacts on the yoke! Tighten the mounting screws after the adjustment is made.

6.7 CONVERGENCE ADJUSTMENT:

6.7.1 Display magenta crosshatch pattern.

6.7.2 Loosen locking ring on yoke and remove all glue from 4 and 6 pole magnet rings.

6.7.3 Adjust for best overall red-blue convergence by:

a) Changing the angle of one 4-Pole magnet ring in respect to the other ring to converge red and blue verticaly *Refer to diagram on page 20.*

b) Rotating both 4-Pole magnet rings simultaneously to converge red and blue horizontally. *Refer to diagram on page 20.*

6.7.4 Display white crosshatch pattern.

6.7.5 Without disturbing the 4-Pole magnets, adjust the 6-Pole magnets to obtain the best overall green to magenta convergence by:

a) Changing the angle of one 6-Pole magnet ring in respect to the other ring to converge magenta and green vertically. *Refer to diagram on page 20.*

b) Rotating both 6-Pole magnet rings simultaneously to converge magenta and green horizontally. *Refer to diagram on page 20.*

6.7.6 Tighten locking ring.

6.7.7 Double check convergence to make sure that tightening the locking ring did not change the magnet positions. If convergence has changed, start again.

6.8 SAFETY CHECKS:

6.8.1 Double check proper operation of High-Voltage Safety Circuit, as in step 6.2.8.

6.8.2 Double check that CRT high voltage is within safe range, as in steps 6.2.4 to 6.2.7.

6.8.3 Make sure that no wires are loose or positioned where they may get pinched against the cover or other components.

6.8.4 Check all locking and retaining devices, to assure they are securely tightened.

6.8.5 Make sure that no loose hardware, tools, etc., have been left in the monitor.

6.8.6 Perform safety checks listed in section 4.

6.9 CLOSING THE MONITOR:

6.9.1 Disconnect power cord and signal cable.

6.9.2 Place the monitor, face down, on a clean padded surface.

6.9.3 Slide the rear cover onto the monitor, checking for proper alignment.

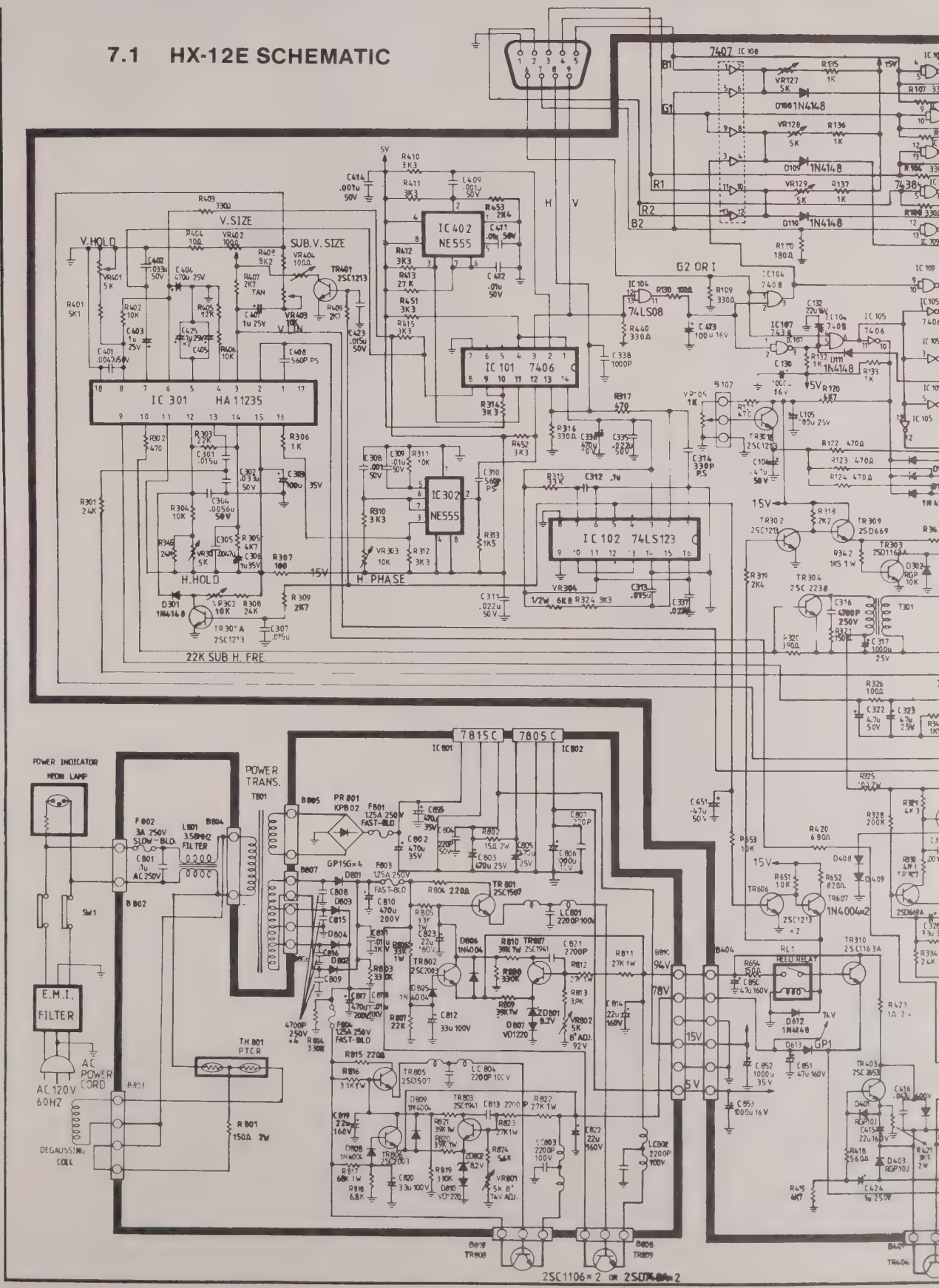
6.9.4 Check that H-HOLD and V-HOLD extension tubes protrude through their openings in the rear cover.

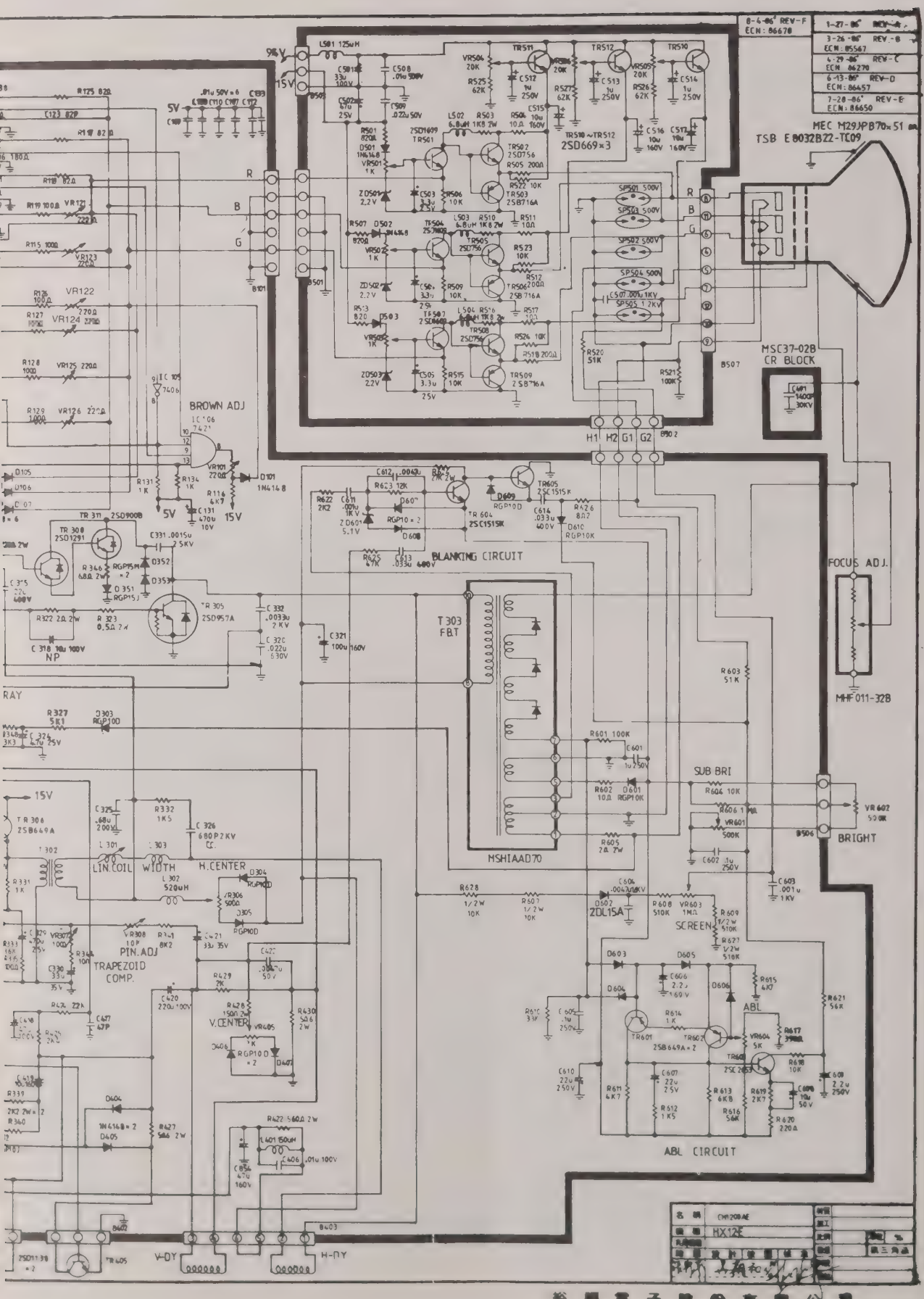
6.9.5 Replace the four original cover screws, and tighten securely.

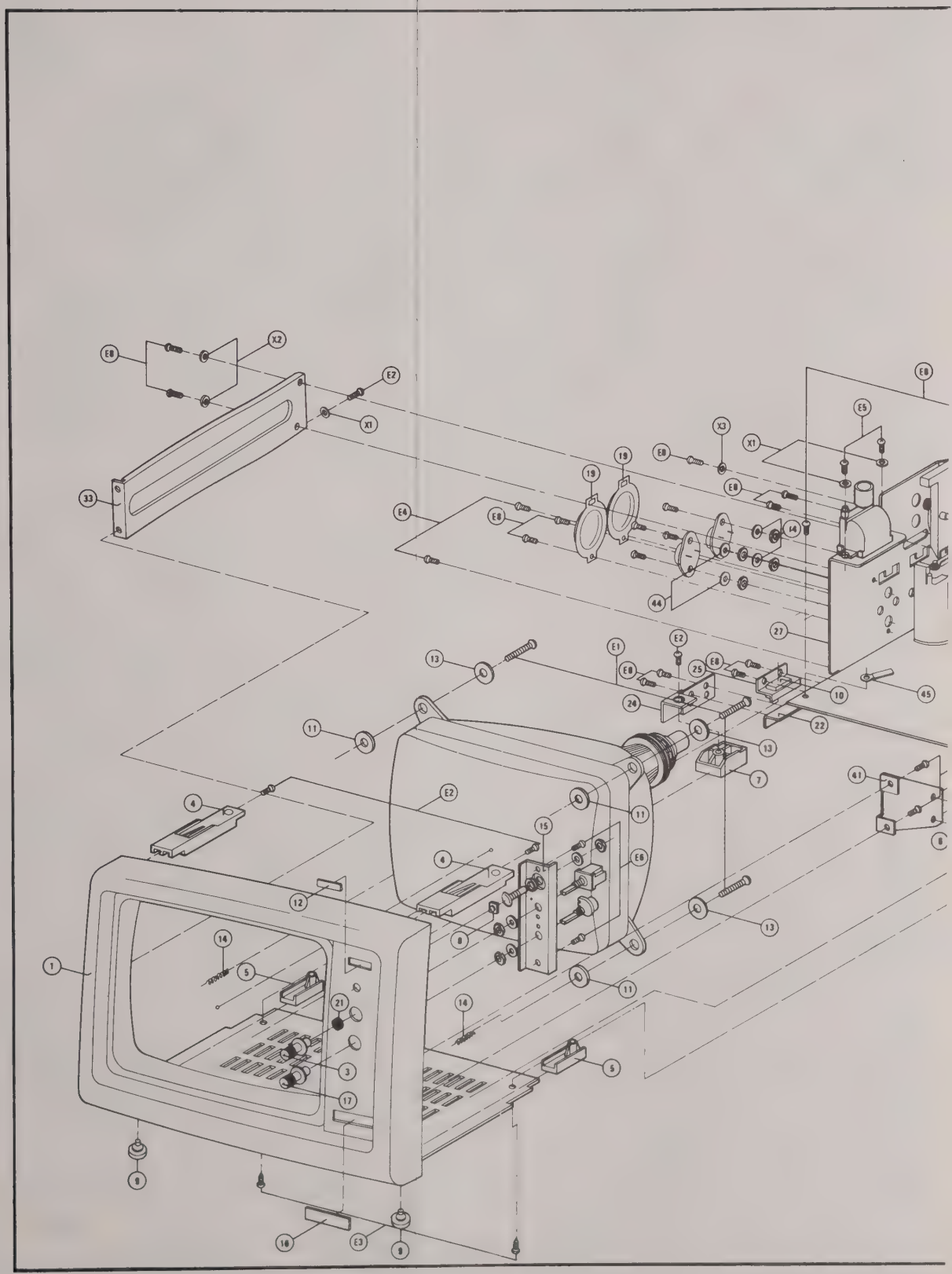
6.9.6 Replace the screw caps.

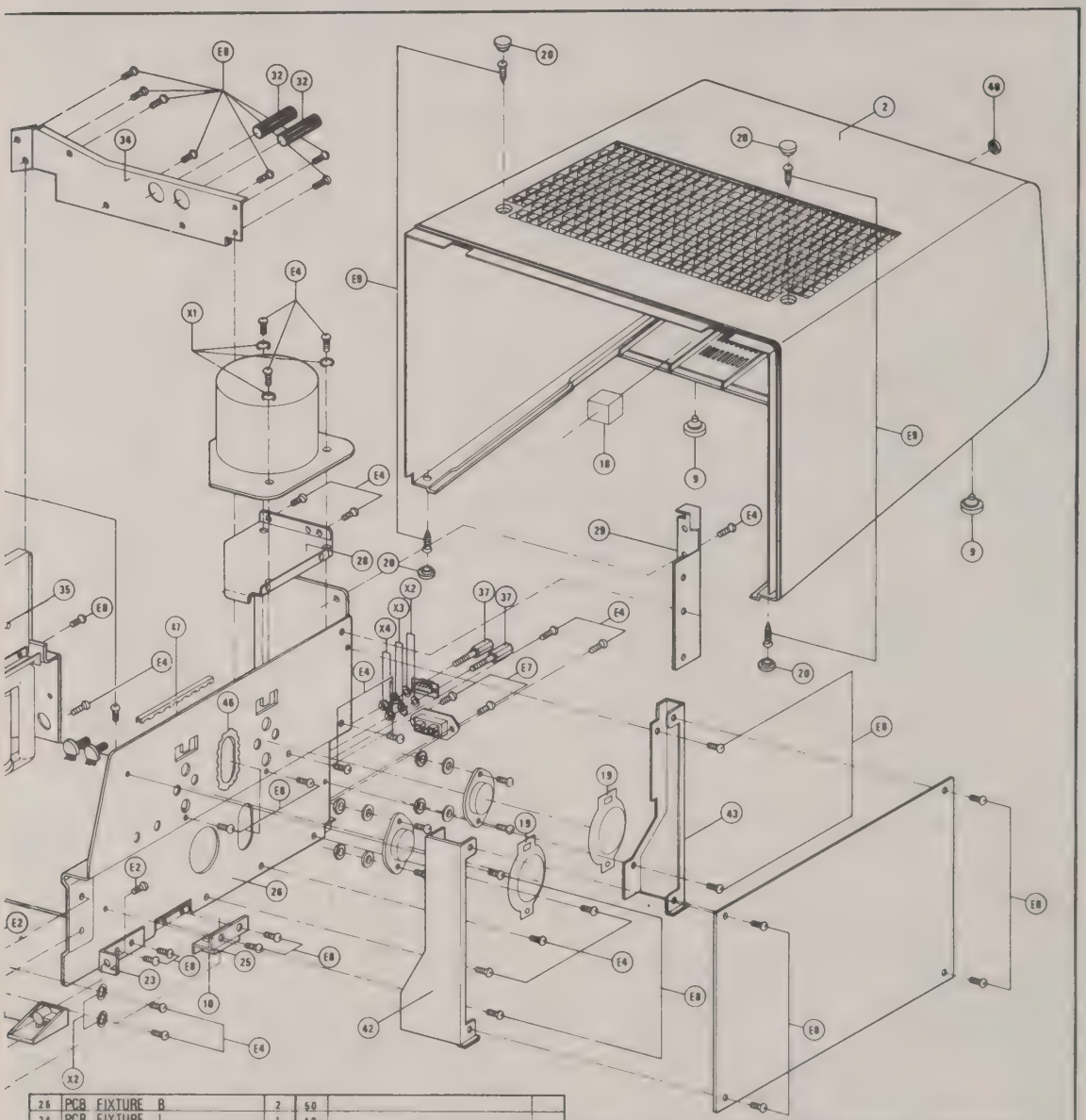
6.9.7 Check cover for any dirt or smudges, and clean with mild, non-abrasive cleanser. DO NOT USE ANY PETROLEUM BASED SOLVENTS.

7.1 HX-12E SCHEMATIC




8-4-86' REV-F
ECN: 86670
1-27-86' REV-A
3-26-86' REV-B
ECN: 85567
4-29-86' REV-C
ECN: 86270
6-13-86' REV-D
ECN: 86457
7-28-86' REV-E
ECN: 86650
MEC M29JPB70×51
TSB E80328Z2-TC09
2SD669×3
MSC37-02B
CR BLOCK
BROWN ADJ
BLANKING CIRCUIT
FOCUS ADJ.
MHF011-32B
T303
FBT
MSHIAAD70
SUB BRI
BRIGHT
SCREEN
ABL
ABL CIRCUIT
LIN.COIL
WIDTH
H.CENTER
PIN.ADJ
TRAPEZOID
COMP.
V.CENTER
V-DY
H-DY
15V
5V
9V
HX12E

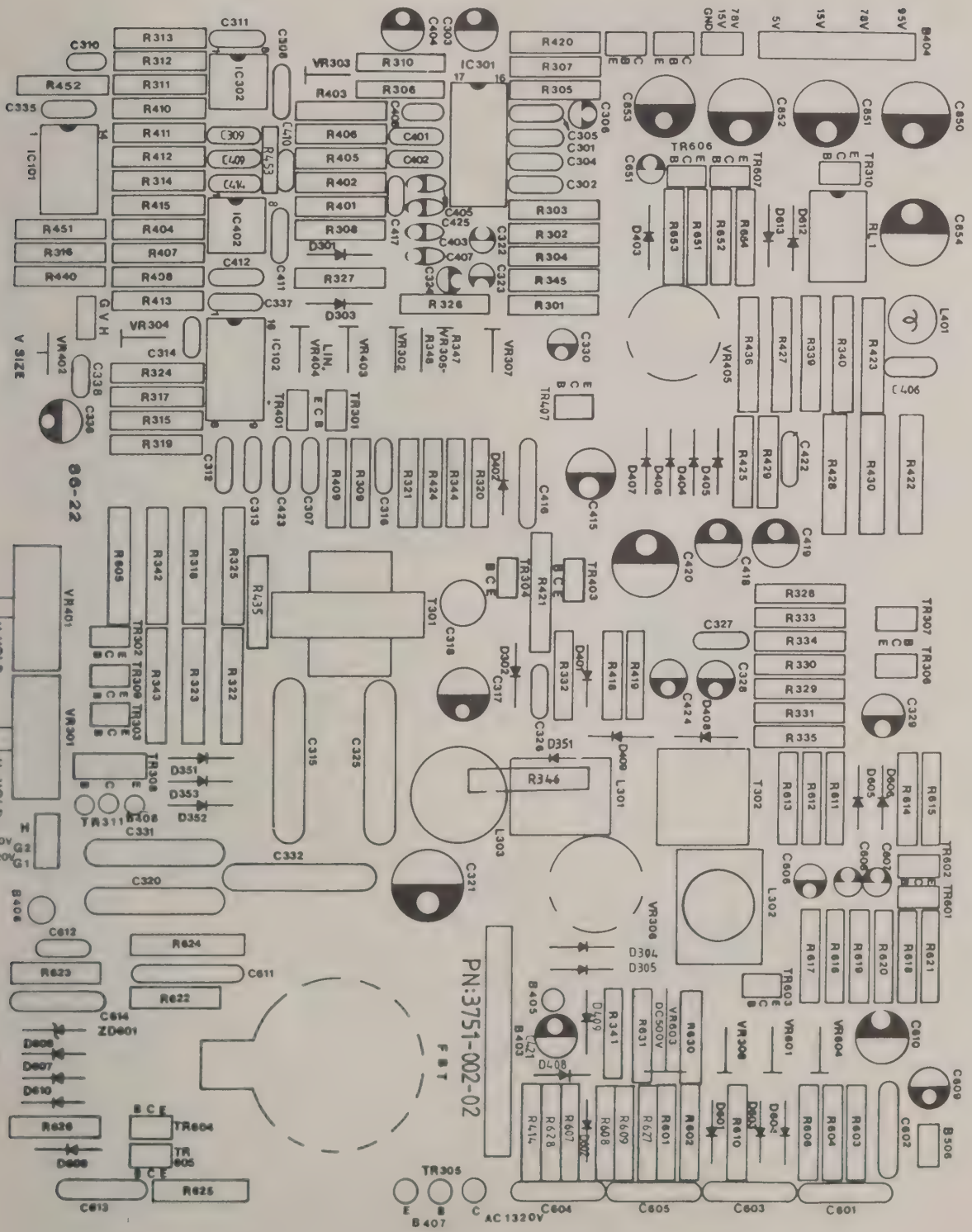

X2
E8
E2
X1
33
E4
E8
19
19
E8
X3
X1
E8
E5
E8
14
44
27
E1
E2
E8
25
E8
24
10
45
22
13
13
11
7
41
8
E2
4
15
11
4
E8
12
8
13
14
1
5
21
3
17
14
5
9
16
E3
9



DET	DESCRIPTION	QTY	DET	DESCRIPTION	QTY
26	PCB FIXTURE B	2	50		
24	PCB FIXTURE L	1	49		
23	PCB FIXTURE R	1	48		
22	PCB FRAME	1	47	FREE BUSHING II	1
21	KNOB SPRING	1	46	FREE BUSHING I	1
20	SCREW COVER(BOTTOM)	6	45	WIRE SADDLE	2
19	INSULATION SHEET	4	44	TR WASHER	4
18	SPONGE CUSHION	1	43	POWER BOARD FIXTURE B	1
17	BRIGHT KNOB	1	42	POWER BOARD FIXTURE A	1
16	NAME PLATE	1	41	PCB RIBBAND R	1
15	KNOB BRACKET	1	40	B PLUS COVER	1
14	GROUND SPRING	2	39	SOCKET COVER WASHER	4
13	CRT WASHER	4	38	SOCKET FIXTURE SCREW	4
12	MODEL OVERLAY	1	37	SOCKET STUD	2
11	RUBBER WASHER	4	36	SOCKET COVER	4
10	INSULATION BRACKET	2	35	FOCUS COVER	1
9	LEG	4	34	PCB RIBBAND B	1
8	NEON LAMP HOOD	1	33	PCB RIBBAND A	1
7	SUPPORTER B	1	32	VR TUBE	2
6	SUPPORTER A	1	31	BINDER	15
5	CONNECTOR BOTTOM	2	30		
4	CONNECTOR TOP	2	29	RIBBAND BRACKET	1
3	ON-OFF KNOB	1	28	TRANS BRACKET	1
2	BACK CABINET	1	27	HOR OUTPUT HEAT SINK	1
1	FRONT CABINET	1	26	POWER IC HEAT SINK	1

DET	DESCRIPTION	QTY	DET	DESCRIPTION	QTY
E10	M3×11 ISO	18			
E9	ø4×14 TAP	4			
E8	ø3×8 TAP	38			
E7	ø3×10 TAP B/H	2			
E6	ø3×10 TAP B/H	2			
E5	ø4×10 TAP B/H	2			
E4	ø4×10 TAP T/H	19	X4	M3 NUT ISO	18
E3	ø4×12 TAP	2	X3	M3 O T W	6
E2	ø4×14 TAP	7	X2	M3 S W	18
E1	ø4×25 TAP	4	X1	M4 S W	10

7.3 HX-12E MAIN PC BOARD LAYOUT *Component Side*


PN:3751-002-02
80-22
95V
78V
15V
5V
GND
IC301
IC302
IC101
IC402
IC102
R420
R307
R305
R310
R306
R403
R406
R405
R402
R401
R308
R327
R326
R303
R302
R304
R345
R301
R313
R312
R311
R410
R411
R412
R314
R415
R404
R407
R408
R413
R452
R451
R316
R440
R324
R317
R315
R319
R436
R427
R339
R340
R423
R425
R429
R428
R430
R422
R328
R333
R334
R330
R329
R331
R335
R605
R342
R318
R325
R435
R343
R323
R322
R346
R418
R419
R332
R421
R409
R321
R424
R344
R320
R609
R608
R607
R628
R414
R627
R601
R602
R630
R631
R341
R611
R612
R613
R614
R615
R617
R616
R619
R620
R621
R618
R623
R624
R622
R626
R625
C850
C851
C852
C853
C854
C851
C852
C853
C310
C311
C308
C309
C409
C410
C335
C453
C411
C412
C337
C314
C338
C336
C312
C313
C423
C307
C316
C416
C415
C420
C418
C419
C422
C406
C401
C402
C403
C407
C404
C405
C425
C417
C322
C323
C324
C303
C306
C305
C301
C304
C302
C330
C327
C328
C424
C329
C326
C317
C318
C315
C325
C332
C320
C321
C331
C611
C612
C614
C613
C604
C605
C603
C601
C602
C609
C610
C606
C607
C608
B404
B405
B406
B407
B408
B409
B306
TR606
TR607
TR310
TR307
TR304
TR403
TR407
TR401
TR301
TR302
TR309
TR303
TR308
TR311
TR602
TR601
TR603
TR604
TR605
TR305
D403
D612
D613
D407
D406
D404
D405
D402
D351
D353
D352
D408
D409
D410
D411
D412
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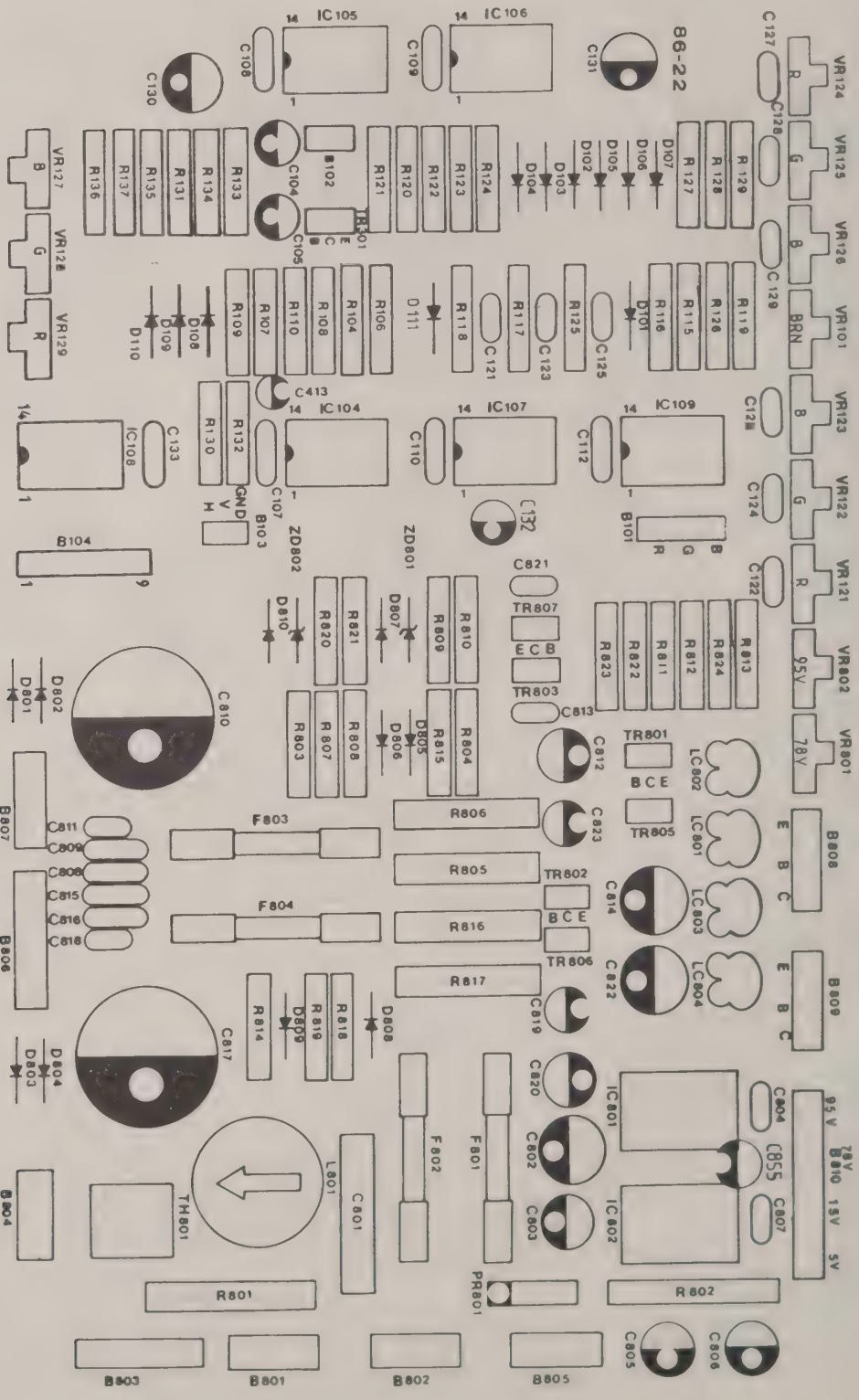
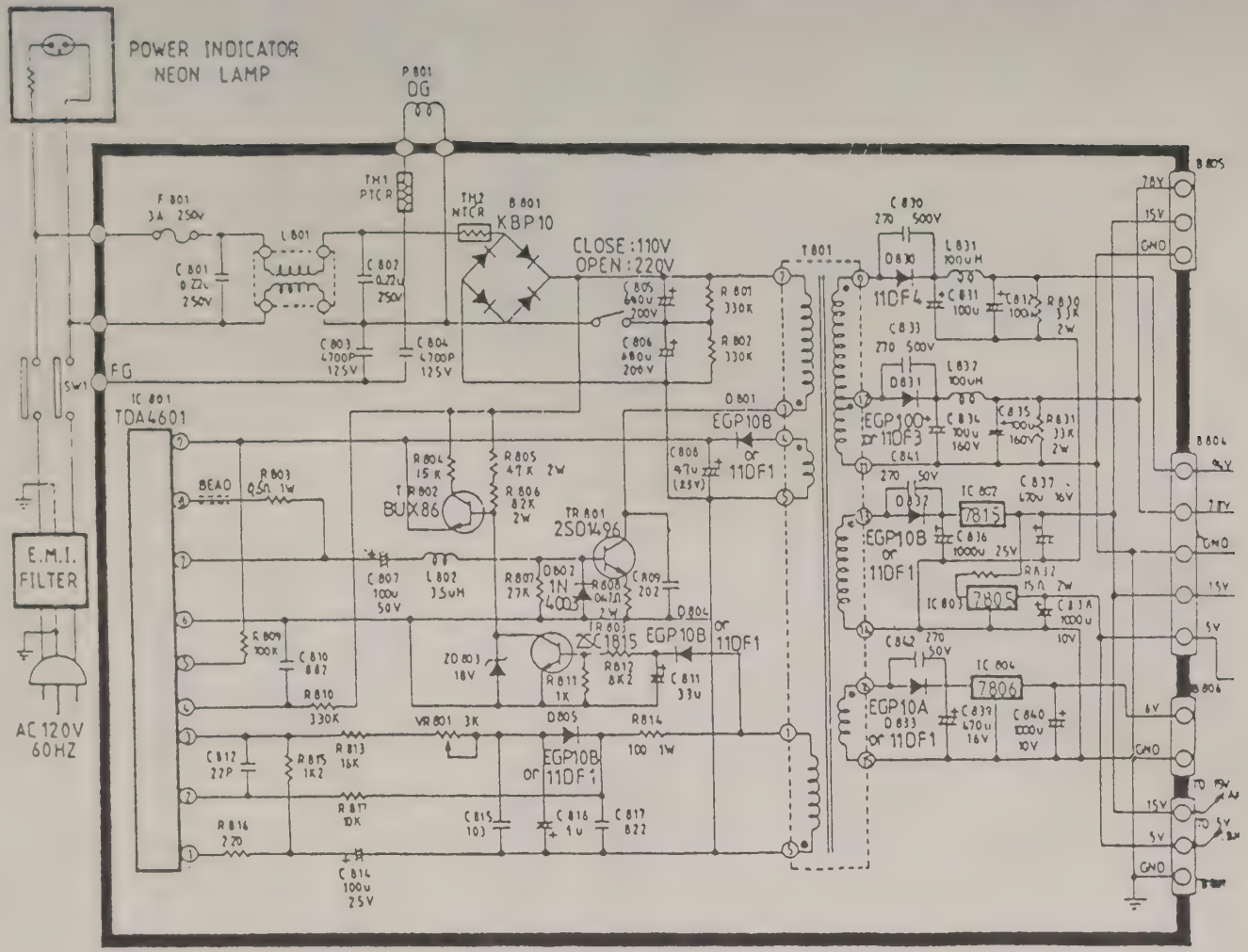
D419
D420
D421
D422
D423
D424
D425
D426
D427
D428
D429
D430
D431
D432
D433
D434
D435
D436
D437
D438
D439
D440
D441
D442
D443
D444
D445
D446
D447

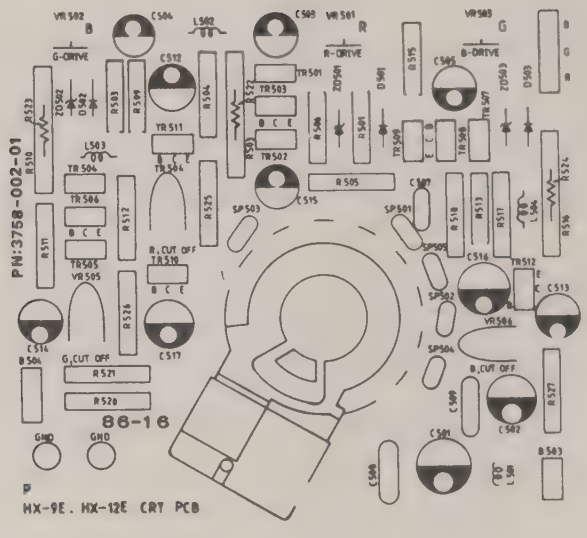
7.4 HX-12E POWER/VIDEO PC BOARD LAYOUT *Component Side*



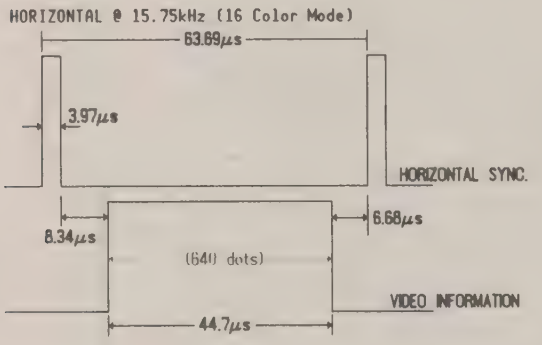
ALTERNATE HX-12E POWER SUPPLY

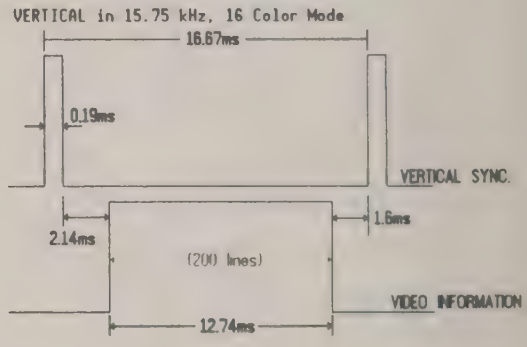


7.5 HX-12E CRT PC BOARD LAYOUT *Component Side*

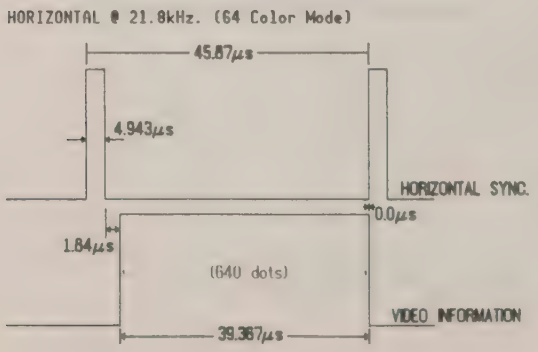


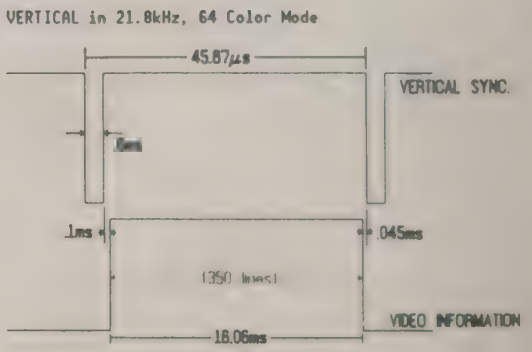
7.6.1 HX-12E TIMING DIAGRAMS *15.75 kHz, 16 Color Mode*





7.6.2 HX-12E TIMING DIAGRAMS *21.8 kHz, 64 Color Mode*





Deflection Yoke

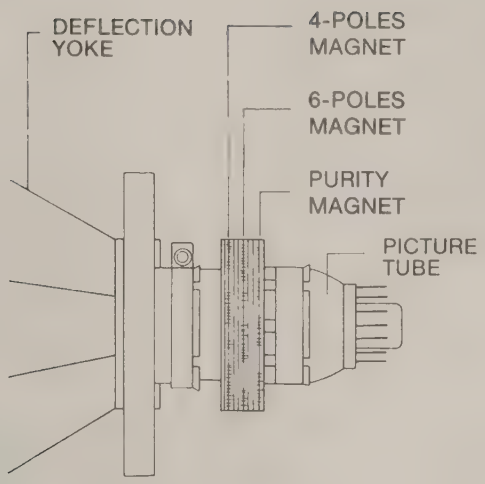


FIGURE 3.

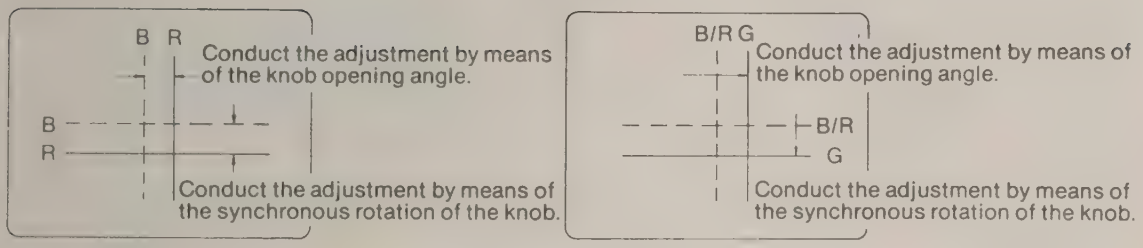
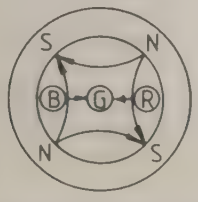
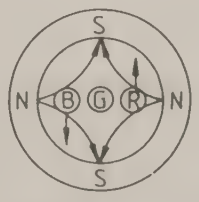

B R
Conduct the adjustment by means of the knob opening angle.
B
R
Conduct the adjustment by means of the synchronous rotation of the knob.
B/R G
Conduct the adjustment by means of the knob opening angle.
B/R
G
Conduct the adjustment by means of the synchronous rotation of the knob.

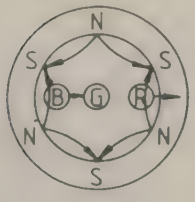
FIGURE 4.



Beam migration in application of 4-pole magnets.



Beam migration in application of 4-pole magnets rotated.



Beam migration in application of 6-pole magnets.

Beam migration in application of 6-pole magnets rotated.

FIGURE 5.

8.0 Troubleshooting Flowchart

NO RASTER (No Power)

Check for 97V and 85V AC between power transformer secondary outputs and ground.	ABNORMAL	Failure of SW1. F801 Open or Damaged. Failure of PTCR and/or degaussing circuit. D801 - D804 shorted. C810 and/or C817 shorted. Failure of T802. Failure of NL1. L801 Open.
↓ NORMAL ↓		
Check for 120V and 105V do between ground and positive side of C810 ad C817 respectively.	ABNORMAL	Failure of D801-D804. Failure of C810 and/or C817. Failure of Horz Output Transistor Failure of Vert Output Transistor
↓ NORMAL ↓		
Check for 94V and 78V dc voltage between ground and emitter of TR808 and TR809 respectively.	ABNORMAL	Failure of IC301. Failure of Horz Oscilator Crct Failure of Horz Drive Circuit. Failure of Horz Output Circuit. Failure of High Voltage Protector. Failure of 94V and/or 74V dc regulator circuit.
↓	NO or LOW 94V 78V dc	Power regulator open.
NORMAL ↓		
Check DC 15V B+	ABNORMAL	Failure of IC801. Fuse F802 open. C802 or C803 shorted.
↓ NORMAL ↓		Failure of T802.
Check TR304 Horz. Drive Output	ABNORMAL	Failure of T301 or TR304. Failure of IC301.
↓ NORMAL ↓		
Check Horz. Output transistor	SHORTED	Replace Horz Output transistor.
output for approximately 920V p-p	ABNORMAL	Failure of Flyback Transformer Failure of C316 and/or C317.
↓ NORMAL ↓		
Check CRT heater.	ABNORMAL	Failure of CRT socket. Failure of CRT. Failure of heater supply crct.
↓ NORMAL ↓		Failure of Flyback Transformer.
Check screen voltage, approx 450V	ABNORMAL	Failure of VR603, D602, R608, C602, C604, and/or R609.
↓ NORMAL ↓		
Check CRT anode voltage, should be approximately 23.5KV	ABNORMAL	Failure of CRT, Flyback Xfrmr

NO IMAGE ON SCREEN

Check for 78V dc between ground and emitter of TR808 ..... ABNORMAL .... Failure of 78V regulator. Failure of TR303 and/or associated circuitry.

↓ NORMAL

Check for 5V dc between ground ..... ABNORMAL .... Failure of IC802 and/or associated circuitry.

↓ NORMAL

Check motherboard connections for CRT board and yoke. ..... ABNORMAL .... Correct or replace faulty connectors B101, B501, B503.

↓ NORMAL

Check output levels of all TTL IC devices. ..... ABNORMAL .... Failure of IC104, IC105, IC106 Failure of IC107, IC109.

↓ NORMAL

Check for 15V dc between ground and B803. ..... ABNORMAL .... Failure in 15V dc loop circuit.

↓ NORMAL

Check CRT Cathode Voltage..... ABNORMAL .... Failure of TR 501 - TR509.

↓ NORMAL

Check G1 and G2 Voltage..... ABNORMAL .... Failure of G1 and/or G2.

↓ NORMAL

PROBABLE FAILURE OF CRT!

NO VERTICAL SWEEP

Chekc IC301 pin 6 voltage for approximately 11.6V. ..... ABNORMAL .... Failure of IC301. Failure of 15V dc supply loop.

↓ NORMAL

Check 94V dc supply. ..... ABNORMAL .... FAILURE OF 94V supply circuit.

↓ NORMAL

Check for approximately 45V dc on output of TR404 and TR405. ..... ABNORMAL .... Failure of TR404 and/or TR405 and/or associated circuitry. Bad transistor/socket contact.

↓ NORMAL

PROBABLE FAILURE OF C420 AND/OR VERTICAL DEFLECTION (DY) COIL

UNSTABLE VERTICAL

Check frequency variation while adjusting Vertical Hold control. ..... 60 Hz UNSTABLE ... Failure of IC402
Failure of IC301 and associated circuitry.

↓

NORMAL

↓

Failure of IC301, IC402,
Failure of C404 VR401 and/or associated circuitry.

↓

UNSTABLE HORIZONTAL

↓

Check Horizontal Mode Control for proper operation.

↓

NORMAL

↓

Check frequency variation while adjusting Horizontal Hold control. ..... ABNORMAL ..... Failure of IC301 and/or IC402.

↓

NORMAL

↓

Failure of IC301, IC302,
Failure of VR301, VR302, R304, R308, D301.
Failure of C304, TR301, R309, C307.

ABNORMAL SCREEN BRIGHTNESS

Check 78V dc supply ..... ABNORMAL ..... Failure of 78V regulator.
Failure of TR501, TR502, TR503.
Failure of TR504, TR505, TR506.
Failure of TR507, TR508, TR509, and/or associated circuitry.

↓

NORMAL

↓

Check G1 Voltage approx. -65V ..... ABNORMAL ..... Failure of G1 voltage supply circuit.
Failure of VR602 and/or associated circuitry.

↓

NORMAL

↓

Check G2 voltage, approx. 450V dc ..... ABNORMAL ..... Failure of G2 supply circuit.
Failure of VR603 and/or associated circuitry.

↓

NORMAL

↓

Check proper adjustment of ABL (Automatic Brightness Limiting) Circuit.

↓

NORMAL

↓

Probable failure of high-voltage section and/or CRT.

CAN NOT PROPERLY ADJUST PINCUSHION and/or BARREL DISTORTION

Check TR306, TR307 voltage ..... ABNORMAL ..... Failure of TR306, TR307 and/or associated circuitry.

↓

NORMAL ..... NONE ..... Failure of C421, R341,
Failure of VR307, VR308 and/or associated circuitry.

↓

Failure of T302

IMAGE CENTERING DEVIATION

VERTICAL.

Can image be centered with Vertical centering control, VR405 ..... NO ..... Failure of D406, D407,
Failure of VR405.
Failure of R428.

↓

YES

↓

Then center display with VR405!

HORIZONTAL:

First try to center display as outlined in SET-UP procedure.

↓

STILL ABNORMAL

↓

Check 78V (15.75KHz) or 94V (22KHz) ..... ABNORMAL.... Failure of 78V or 94V loop circuit.

↓

NORMAL

↓

In 15.75KHz mode:
Failure of D304, D305.
Failure of VR306.
Failure of L302.
Failure of R332, C326.

↓

In 21.8KHz mode:
Failure of C304, R304, VR301.
Failure of VR302.
Failure of C301, R308, D301
Failure of IC301
Failure of IC302, VR303, and/or associated circuitry.

CRT ANODE HIGH VOLTAGE TOO HIGH

Follow SET-UP procedure.

↓

STILL ABNORMAL

↓

Check Flyback pin-8 voltage ..... ABNORMAL.... Failure of power regulator.
Should be 78Vdc in 15.75 KHz mode or
94 Vdc in 21.8 KHz mode ..... Failure of frequency sensor circuit IC102.
Failure of TR606, TR607, TR804, and/or associated circuity.

↓

NORMAL

↓

Check TR302, TR308, TR309 switch circuit for proper operation
TR308 and TR309 should be in saturation in 15.75KHz mode ..... ABNORMAL.... Failure of TR308.
Failure of TR309.

↓

NORMAL

↓

PROBABLE FAILURE OF C331; open!

VERTICAL RETRACE BOOSTER

Check TR403 collector for 94Vdc ..... ABNORMAL.... Failure of power regulator.

↓ NORMAL

Check D402 Cathode for 60V p-p..... ABNORMAL.... Failure of TR403.
Failure of R418, R419, C423.
Failure of D401, D402, and/or associated circuitry.

↓ NORMAL

Check retrace time in 21.8KHz mode. Should be less than 500μs

HORIZONTAL FREQUENCY AUTO SENSOR

Check IC102 pin 2 for..... ABNORMAL.... Failure o R317, C314.
Horizontal Sync. signal input. Loose signal cable.
Loose wire from signal input connector.

↓ NORMAL

Adjust VR304 and check IC102 pin..... ABNORMAL.... Failure of IC102, VR304
5 or 12 for logic level change and associated circuitry.

↓ NORMAL

Check IC102 pin 5 as follows ..... ABNORMAL.... Re-adjust VR304 per SET-UP.
pin 5 should be high at 15.75KHz.
pin 5 should be low at 21.8KHz.

↓ NORMAL

CHECK TR606, TR607, RL1, TR310 ..... ABNORMAL.... Failure of TR606, TR607, RL1,
for proper operation. TR310 and associated circuitry.

↓ NORMAL

In 15.75KHz mode, check output of ..... ABNORMAL.... Failure of TR301 and/or
TR301 while adjusting VR302. Does associated circuitry.
the output vary normally?

↓ NORMAL

In 15.75KHz mode, check output of ..... ABNORMAL.... Failure of TR401 and/or
TR401 for normal variation while associated circuitry.
Adjusting VR404

↓ NORMAL

Possible features of TR308, C331, TR310 and/or TR303, C315.

ABNORMAL DISPLAY

Check 9-pin signal input connector for proper TTL levels on all lines and trace to main board. ..... ABNORMAL.... Loose signal cable. Failure of connector.

↓ NORMAL

Check connector B501 for proper R,G,B signals. ..... ABNORMAL.... Loose connection from B101 to B501. Failure of IC104, IC105, IC106 and/or IC107.

↓ NORMAL

Check CRT R,G,B cathodes for approximately 52V p-p. ..... ABNORMAL.... Failure of video output(s); RED: TR501, TR502, TR503; GRN: TR504, TR505, TR506; BLU: TR507, TR508, TR509; and/or associated circuitry.

↓ NORMAL

↓ PROBABLE FAILURE OF CRT!

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